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Sugarcane Response to Bermudagrass Interference

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The competitiveness of three phenotypically different sugarcane cultivars with bermudagrass was determined in field trials. In trial one, bermudagrass biomass was 22% less in CP 70-321 than in HoCP 85-845 in the plant-cane crop, but biomass was 130 to 170% greater in CP 70-321 than in the other two cultivars during the second-ratoon crop. CP 70-321 emerges quickly following planting, which might have reduced bermudagrass growth in the plant-cane crop, but the lower stalk population of CP 70-321 might have promoted bermudagrass survival and growth during the second-ratoon crop. In trial two, there were no differences in bermudagrass biomass when comparing its establishment in the different cultivars. Sugarcane, averaged across cultivar, produced fewer stalks and was shorter when competing with bermudagrass. In the plant-cane crop, stalk populations were reduced 13 to 23%. In the first-ratoon crop, stalk population was reduced 8 to 15%. In the second-ratoon crop, stalk population was reduced 8 to 10%. Bermudagrass interference reduced sugar yields by 8 to 32% in the plant-cane crop, with reductions of no more than 9% in the first- and second-ratoon crops. The greater yield loss in the plant-cane crop in the first production year shows the importance of controlling bermudagrass in the summer fallow period prior to planting and during establishment of the plant-cane crop.
Nomenclature: Bermudagrass, *Cynodon dactylon* L. Pers. CYNDA; sugarcane, *Saccharum* interspecific hybrids 'CP 70-321', 'LCP 85-384', 'HoCP 85-845'.
Key words: Weed competition, weed interference.

Bermudagrass is a troublesome perennial weed problem for Louisiana sugarcane growers. Sugarcane in Louisiana is planted vegetatively (using stalk pieces) in late summer or early autumn and is cultivated as a perennial crop lasting 3 to 4 yr. During this 3- to 4-yr cropping period, tillage is limited to the row sides and bottoms, and once perennial weeds such as bermudagrass become established, they are difficult to control.

Following the final production year, sugarcane fields are generally deeply tilled using a disk plow to destroy sugarcane plants after which fields are generally left fallow or occasionally are planted with a spring-seeded crop such as soybean [*Glycine max* (L.) Merr.] until they are replanted with sugarcane. This fallow or rotational period is the optimal time for controlling bermudagrass in sugarcane fields through combinations of tillage and herbicide applications (Richard 1997).

When bermudagrass is not sufficiently controlled during the fallow period or when sugarcane is replanted immediately following harvest (succession planted), bermudagrass can easily re-establish from viable rhizome and stolon pieces (Fernández 2002) in newly-planted sugarcane. Once established, it often remains a management problem for the entire crop cycle. Low bermudagrass infestations, when left unchecked, can quickly expand due to prolific production of stolons and rhizomes (Horowitz 1972b). In cotton (*Gossypium hirsutum* L.), bermudagrass planted at a rate of 1 plant per 7.5 m of row spread to 25% groundcover the first year and to75% groundcover in the second year (Brown et al. 1985).

Bermudagrass infestations within sugarcane can be suppressed with applications of herbicides such as terbacil or metribuzin or with herbicide combinations such as clomazone plus diuron or hexazinone plus diuron if applications are made prior to bermudagrass emergence in autumn following planting (Richard 2000) or in the spring before it emerges from winter dormancy (Anonymous 2006; Richard 1993). But once established within a sugarcane crop, complete bermudagrass control is rarely achieved.

Bermudagrass is limited in its ability to compete with sugarcane because of its prostrate growth habit and intolerance to shading (Horowitz 1972a), and responds to shading by increasing dry matter allocation to above-ground organs such as leaves and stolons (Dong and Pierdominici 1995; Fernández et al. 2002). Interference with sugarcane is most critical following planting and in the spring before sugarcane forms a dense canopy over the low-growing bermudagrass, which goes into a shade-induced dormancy in late summer. This interference, under heavy infestations, has been reported to reduce sugarcane yields by as much as 26% (Richard 1997). Bermudagrass interferes with sugarcane by shading emerging sugarcane shoots and can reduce tiller formation and survival. It also competes for soil nutrients (Weller et al. 1985) and produces allelochemicals which can also inhibit sugarcane growth (Vasilakoglou et al. 2005).

Sugarcane cultivars vary in phenotypic characteristics such as quickness to emerge following planting in the fall; vigor of spring emergence following winter dormancy; stalk population; canopy characteristics, such as leaf architecture; and ratooning ability (measured by survival and vigor of the crop following repeated annual harvests); all of which may affect their competitiveness with bermudagrass. A quick-emerging cultivar with a dense stalk population and good ratooning ability that quickly and fully shades the low-growing bermudagrass would be expected to be most competitive with bermudagrass. However, the competitiveness of sugarcane with weeds such as bermudagrass, is not part of the selection process for the development of new cultivars, and any advantage or disadvantage most likely would be coincidental.

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The objectives of this research were to determine if any differences in competitiveness exist among cultivars with differing phenotypic characteristics, and to determine the effects of bermudagrass interference on sugarcane growth and yield during a 3-yr sugarcane cropping cycle (plant-cane, first-ratoon and second-ratoon).

Materials and Methods

Two field studies were conducted, each for a 3-yr sugarcane crop cycle, to examine the effects of bermudagrass interference on sugarcane growth and yield. The first was planted on September 10, 1996 and was terminated following harvest in 1999 (trial 1), and the second was planted on September 16, 1997 and terminated following harvest in 2000 (trial 2). Studies were conducted in separate fields with histories of dense bermudagrass infestation at the U.S. Department of Agriculture, Agriculture Research Service, Ardoyne Farm in Schriever, LA. The soil type in both fields was a Mhoon silty clay loam (fine-silty, mixed, superactive, nonacid, thermic Fluvaquentic Endoaquepts). Studies were arranged in a split-plot randomized complete block design with six replications where sugarcane cultivar was the main plot and duration of bermudagrass interference was the subplot. Main plots (sugarcane cultivar) consisted of three, 1.8 m wide, raised-bed rows that were divided into subplots 8 m in length. Subplots were randomly assigned one of five levels of bermudagrass duration of interference within each main plot.

Sugarcane cultivars CP 70-321, HoCP 85-845, and LCP 85-384 were selected for comparison in this study. These sugarcane cultivars were selected because they were the predominant cultivars grown in Louisiana during the trial period, and because they vary in characteristics that could potentially influence their competitiveness with bermudagrass. CP 70-321 (Fanguy et al. 1979) emerges quickly following planting, but has a relatively lower stalk population and does not ratoon as well as the other cultivars in this study. LCP 85-384 (Milligan et al. 1994) is relatively slow to emerge following planting and in the spring, but produces a high population of stalks and has good ratooning ability. HoCP 85-845 (Legendre et al. 1994) is intermediate in the traits described for the other two cultivars in this experiment.

The five durations of interference were: (1) weed free, complete bermudagrass control throughout the crop cycle beginning immediately following planting; (2) plant cane establishment, bermudagrass was allowed to interfere only during the establishment period during the fall and winter following planting and bermudagrass was controlled beginning in March of the plant-cane crop and throughout the remainder of the crop cycle; (3) 1-yr, bermudagrass interference during the entire plant-cane crop with control beginning in March during the first-ratoon crop and though the end of the crop cycle; (4) 2-yr, interference during both the plant-cane and first-ratoon crops with control beginning in March during the second-ratoon crop; and (5) 3-yr, bermudagrass allowed to interfere for entire crop cycle (plant-cane, first-ratoon, and second-ratoon crops). Duration of interference treatments were established in designated plots by hand hoeing to remove (control) bermudagrass on a regular basis beginning in March and then as needed every 2 to 3 wk until canopy closure, except in the completely weed-free plots where removal began in the fall after planting. The initiation of hoeing in the spring coincided with the general greening of the sugarcane and bermudagrass following winter-induced dormancy. Although care was taken during hand-hoeing of plots to avoid damage to the sugarcane crop, it is inevitable that a few of the sugarcane tillers were destroyed and some root-pruning occurred, but the effects to the sugarcane crop were minimal. Hoeing is the only method available for removing established bermudagrass from growing sugarcane, because no herbicides are effective at controlling bermudagrass in sugarcane.

In preparation for planting, row-sides and middles were cultivated using a rolling disk cultivator, and rows were opened using a planting furrow plow. Sugarcane was hand-planted by successively placing two sugarcane stalks side by side lengthwise within the planting furrow with a 10% overlap at the ends. The planting furrow was then treated with carbofuran at 2.8 kg ai/ha, within a 0.9 m band, to control wireworms. Stalks were covered with soil to a depth of 8 cm using two opposite-direction passes of a covering tool (a modified rolling disk cultivator). Rows were packed using a rolling drum packer and pendimethalin plus diuron (3.4 plus 2.2 kg ai/ha) was applied in a 0.9 m band over the planted row to control weeds other than bermudagrass. In 1996 (trial 1), sugarcane emerged (constituted by emerging shoots at regular intervals across the entire length of the plot) on October 3, October 10, and October 21 (23, 30, and 41 days after planting), respectively, for cultivars CP 70-321, HoCP 85-845, and LCP 85-384. In 1997 (trial 2), sugarcane emerged on October 6, October 12, and October 20 (21, 27, and 35 days after planting), respectively, for cultivars CP 70-321, HoCP 85-845, and LCP 85-384.

Conventional sugarcane production practices were employed each year of the crop cycle for both studies (Legendre 2001). Plots were off-bar cultivated in March of each year, where all soil but the 60 cm row-top is cut away using a disk cultivator, and a second set of disks reopen the row furrow, depositing the soil on the row sides with shields to prevent soil from being deposited on the row tops. In late March or early April of each year, liquid fertilizer was injected about 15 cm deep on both sides of the undisturbed row top at a rate of 112 kg/ha N, 34 kg/ha P_2O_5, and 67 kg/ha K_2O. Following fertilization and again in late April of each year, row sides and middles were cultivated using a rolling disk cultivator angled so that soil was not deposited onto the undisturbed row top. These tillage operations are typical in Louisiana sugarcane production and reduce herbicide input needs by removing weeds from the row middles so that spring-applied herbicides need only be applied in a band over the row top. In late May or early June of each year, layby tillage was performed using a rolling disk cultivator angled to deposit 2 to 4 cm of soil onto the row top.

Pendimethalin plus diuron (3.4 plus 2.2 kg/ha) was applied in a 0.9 m band to all plots each spring following removal of bermudagrass from designated treatments. Pendimethalin plus atrazine (3.4 plus 3.4 kg ai/ha) was broadcast-applied as

Table 1. Aboveground dry biomass of bermudagrass harvested from sugarcane rows after sugarcane canopy closure during a 3-yr production cycle.

Crop year	Trial 1 (1997–1999)			Trial 2 (1998-2000)		
	CP 70-321	HoCP 85-845	LCP 85-384	CP 70-321	HoCP 85-845	LCP 85-384
	kg/ha					
Plant cane	1,760 aB[a]	2,250 aA	2,030 aAB	720 bA	830 bA	590 bA
First ratoon	310 cA	260 bA	320 bA	1,340 aA	1,540 aA	1,320 aA
Second ratoon	1,140 bA	420 bB	550 bB	950 abA	610 bA	690 bA

[a] Means within columns followed by the same lower case letter are not significantly different and means within rows (within each trial) followed by the same uppercase letter are not significantly different using the *F*-probability values and the PROC MIXED macro described by Saxton (1998) at alpha 0.05.

a directed treatment to all plots following layby cultivation to control seedling grasses and broadleaf weeds such as morningglory (*Ipomoea* spp.). These herbicides were utilized to keep weed species other than bermudagrass from interfering with sugarcane growth and production.

To assess bermudagrass development over one, two, and three production years, aboveground biomass of bermudagrass was hand-harvested, using hand clippers, removing all aboveground leaf and stem pieces from two random 0.9 m row-lengths from each row in each plot (total of 4.9 m^2) following canopy closure in late June or early July each year from designated treatments. Bermudagrass was placed in cloth bags and dried in a forced-air oven at 66 C for a minimum of 72 h after which dry biomass was determined. Numbers of harvestable sugarcane stalks (number per plot) and stalk heights (4 per row) were measured in August each year.

Sugarcane plots were harvested using a whole-stalk mechanical harvester which cut sugarcane stalks at the base, removed the tops and piled the stalks in heaps where they were burned to remove extraneous leaf matter and then loaded into wagons. Weights of harvested cane were recorded using a grab-loader equipped with a weigh cell capable of measuring weights of each grab of cane. From these grab weights, gross sugarcane yields (Mg/ha) were calculated. Harvest dates for trial 1 were: plant cane, November 19, 1997; first ratoon, December 5, 1998; second ratoon, October 28, 1999. Harvest dates for trial 2 were: plant cane, December 2, 1998; first ratoon, November 15, 1999; second ratoon, October 19, 2000.

Sugar content was determined from a randomly collected 15-stalk sample of harvested cane from each plot. Samples were analyzed for sugar content using the conventional core-press method (Legendre 1992). Entire stalks were cut into pieces approximately 0.5 m in length and then placed into a pre-breaker[1] which shredded the stalk pieces with a combination of several rotary and fixed blades. A 1-kg sample of the shredded stalks was placed into a hydraulic press[1] for 2 min at 21 MPa to express juice from the sugarcane. Expressed juice was analyzed for Brix (% by weight of soluble solids) and pol (percent apparent sucrose by weight) using a refractometer[2] and saccharimeter,[3] respectively. Wet weights of the remaining filter cake (fibrous stalk matter) were recorded, and then the filter cakes were placed into a forced-air oven at 66 C for a minimum of 72 hr after which dry weights were recorded. Theoretically recoverable sugar (TRS) was determined from these analyses and measurements using standard methodologies (Legendre 1992; Legendre and Henderson 1972). Sugar yield (kg/ha) represents the product of TRS (kg/Mg) and gross cane yield (Mg/ha).

Data were analyzed as a split-plot using Proc Mixed in SAS[4], with the PDIFF option ($P < 0.05$) of the lsmeans statement along with the Saxton macro (Saxton, 1998) being used for means separation. Treatment and cultivar were considered fixed, whereas location, reps, and interactions with location or rep were defined as random variables. When location by treatment interactions occurred, data are presented separately for each location. During the plant-cane season only three interference treatments occurred (weed-free, plant-cane establishment-only, and 1-yr) as this was the first crop-year. Therefore, plots assigned to 2 and 3 yr of interference were included in the analysis as having just 1 yr of interference. During the first-ratoon season 4 interference treatments were imposed (weed-free, plant-cane establishment-only, 1-yr, and 2-yr). Therefore, plots assigned to 3-yr of interference were included in the analysis as having 2 yr of interference.

Results and Discussion

The aboveground biomass of bermudagrass harvested from sugarcane plots after canopy closure varied between production years (plant-cane, first-ratoon, second-ratoon). When comparing bermudagrass biomass within the cultivars in the plant cane of trial 1 (1997), biomass of bermudagrass harvested from CP 70-321 was less than that from HoCP 85-845 (Table 1). Differences among cultivars were not observed in first-ratoon. In the second ratoon of trial 1 (1999) biomass of bermudagrass in CP 70-321 was greater than that in the other two cultivars. The reduced amount of bermudagrass in the plant-cane crop of CP 70-321 might be related to this sugarcane cultivar's earlier emergence following planting compared to the other two cultivars, whereas the greater amount in the second-ratoon crop might be related to its relatively lower stalk population within the second-ratoon crop (Table 2).

In trial 1, bermudagrass biomass was greatest during the plant-cane crop, whereas in trial 2 it was greatest in the first-ratoon crop (with the exception of bermudagrass biomass in CP 70-321, where biomass was similar during the first-ratoon and second-ratoon crops (Table 1). It is unclear why bermudagrass biomass increased in the first-ratoon crop compared with the previous crop of trial 2. Perhaps it was related to seasonal environmental variations that favored its

Table 2. Number of harvestable sugarcane stalks for cultivars CP 70-321, HoCP 85-845, and LCP 85-384, averaged across duration of bermudagrass interference treatment.[a]

Crop Year	Trial 1 (1997–1999)			Trial 2 (1998–2000)		
	CP 70-321	HoCP 85-845	LCP 85-384	CP 70-321	HoCP 85-845	LCP 85-384
	stalks/ha × 100					
Plant cane	557 b[b]	537 b	609 a	770 ab	754 b	803 a
First ratoon	814 c	878 b	972 a	839 a	859 a	869 a
Second ratoon	712 b	911 a	952 a	963 c	1,020 b	1,090 a

[a] Durations of interference were: plant-cane establishment only, after planting in the fall until early spring; 1-yr, interference during the entire plant-cane crop; 2-yr, interference during both the plant-cane and first-ratoon crops; 3-yr, interference for entire 3-yr crop cycle.

[b] Means within rows (within each trial) followed by the same letter are not significantly different using the *F*-probability values and the PROC MIXED macro described by Saxton (1998) at alpha 0.05.

growth during that season along with its poorer establishment during the plant-cane crop year relative to what occurred in trial 1. Differences between locations in bermudagrass establishment during the plant-cane crop are most likely related to differences in rainfall in the month following planting. Following planting in 1996 (trial 1), 98 mm of rain fell in the two weeks following planting and 215 mm of rain fell during the two months following planting. Following planting in 1997, there was no significant rainfall (> 0.25 mm) in the two weeks following planting, with the first significant rainfall (28 mm) occurring 28 days after planting; only 124 mm of rain fell in the two months following planting. The earlier and greater rainfall following planting in 1996 likely improved bermudagrass establishment in trial 1, resulting in higher levels of bermudagrass biomass in the plant-cane crop (Table 1).

When bermudagrass was allowed to remain through the second-ratoon crop, its biomass still did not exceed the biomass in the plant cane. Previous research with older and less aggressive cultivars showed that sugarcane planted into a field densely infested with bermudagrass was fairly competitive with bermudagrass in the ratoon crops (Richard and Dalley 2005). This is opposed to other research showing expanding bermudagrass infestation over time (Brown et al. 1985; Horowitz 1972b). However, their research was conducted on fallow ground (Horowitz 1972b) and in cotton (Brown et al. 1985), which does not exert a competitive pressure on the bermudagrass similar to that of sugarcane. This research shows that sugarcane is very competitive with bermudagrass and does not allow for its unlimited expansion.

Sugarcane cultivars produced different numbers of harvestable stalks each year. In regard to stalk population in the plant cane crop when averaged across bermudagrass interference treatments, LCP 85-384 had 9 and 13% more stalks than CP 70-321 and HoCP 85-845, respectively in trial 1 (1997), and 6% more than HoCP 85-845 in trial 2 (1998) (Table 2). In the first-ratoon crop in trial 1 (1998), LCP 85-384 had 11 and 19% more stalks than HoCP 85-845 and CP 70-321, respectively, whereas in trial 2 (1999) there were no significant differences in stalk population among cultivars. In the second-ratoon crop, LCP 85-384 had 34% more stalks than CP 70-321 in trial 1 (1999). In trial 2 (2000), in the second ratoon, LCP 85-384 had 7 and 13% more stalks than HoCP 85-845 and CP 70-312, respectively (Table 2). The lower stalk population of CP 70-321, especially in the second ratoon, might be responsible for the increased bermudagrass biomass that occurred in the second ratoon of trial 1 (1999) (Table 1). Although stalk population was also less in CP 70-321 in trial 2, there was no significant response in bermudagrass biomass in the second ratoon. The disagreement in response between the locations is probably related to stalk populations in second-ratoon. In trial 1, stalk population for CP 70-321 was 25% less than LCP 85-384, whereas stalk population for CP 70-321 in trial 2 was 12% less than LCP 85-384.

One of the most notable responses of sugarcane to bermudagrass interference was the reduction in the number of harvestable stalks. Failure to control bermudagrass during any crop year resulted in fewer harvestable stalks, averaged across cultivar, because no interaction between cultivar and interference treatment occurred (Table 3). In the plant-cane crop of trial 1 (1997), the number of stalks was reduced 24 and 23% when bermudagrass interfered after planting (1996) during plant-cane establishment only, and for 1-yr duration (entire plant-cane season; fall 1996 through harvest 1997), respectively. In trial 2, the number of stalks in the plant-cane crop was only reduced (13%) when bermudagrass interfered for 1 yr (from fall 1997 after planting through plant-cane harvest 1998). The difference between locations is probably due to the higher amounts of bermudagrass in the plant-cane crop of trial 1 (1997) compared to trial 2 (1998) (Table 1).

In the first-ratoon crop of trial 1 (1998), all durations of bermudagrass interference (plant-cane establishment only, 1996 planting until spring of 1997 plant-cane crop; 1-yr, 1996 planting through 1997 plant-cane harvest; and 2-yr, 1996 planting through 1998 first-ratoon harvest) resulted in fewer harvestable stalks than the weed-free treatment (Table 3). The 2-yr duration (1996 through 1998) had the fewest stalks (15% less than the weed-free) followed by 1-yr (1996 through 1997) (10% less) and plant-cane establishment only (1996) treatments (8% less). Of interest is that for the 1-yr and plant-cane establishment only duration of interference treatments, plots were kept free of bermudagrass during the entire first-ratoon crop year. The reduction in stalk numbers in the 1-yr and plant-cane establishment only duration treatments might be attributed to interference that occurred during the fall after planting and in the plant-cane crop that reduced the numbers of tillers in the plant-cane crop, which resulted in fewer tillers being produced in the first-ratoon crop. In trial 2 (1999) where initially in the plant-cane crop bermudagrass biomass was lower (Table 1), reductions in the

Table 3. Number of harvestable sugarcane stalks, averaged over cultivar, resulting from differing durations of bermudagrass interference in each year of a 3-yr crop production cycle.

	Trial 1 (1997–1999)			Trial 2 (1998–2000)		
Duration of interference[a]	Plant	First ratoon	Second ratoon	Plant	First ratoon	Second ratoon
	stalks/ha × 100					
Weed-free	699 a[b]	982 a	905 a	849 a	898 a	1,060 a
Fall only	534 b	903 b	856 bc	817 a	861 ab	1,050 a
1-yr	541 b	888 b	874 ab	737 b	862 ab	1,030 ab
2-yr		833 c	846 bc		828 b	1,010 bc
3-yr			811 c			978 c

[a] Durations: Fall-only, after planting in the fall until early spring; 1-yr, interference during the entire plant-cane crop; 2-yr, interference during both the plant-cane and first-ratoon crops; 3-yr, interference for entire 3-yr crop cycle.

[b] Means within columns followed by the same letter are not significantly different using the *F*-probability values and the PROC MIXED macro described by Saxton (1998) at alpha 0.05.

number of harvestable stalks occurred in the first-ratoon crop only when bermudagrass was allowed to interfere for 2 yr (8% less) (Table 3).

In the second-ratoon crop of trial 1 (1999), stalk population was reduced 7% and 10% by 2 and 3 yr of bermudagrass interference, and there was a 5% reduction in stalk population in the plant-cane establishment-only treatment (Table 3). In trial 2 (2000), the 2- and 3-yr duration of interference treatments reduced harvestable stalks by 4 and 7%, respectively, compared to the weed-free control.

Bermudagrass interference reduced sugarcane stalk height to a lesser extent but in a fashion similar to stalk population, with the greatest impact occurring in the plant-cane crop (data not shown). Bermudagrass interference only rarely affected TRS with significant reductions credited to bermudagrass interference occurring only in the plant-cane crop of trial 1 (1997) (data not shown). For this reason only sugar yields, the product of TRS and gross cane yield, are reported.

Sugarcane responded to bermudagrass similarly regardless of which cultivar was grown; therefore, yields were averaged across cultivar. Bermudagrass interference reduced sugar yields in the plant-cane crop 32% in trial 1 (1997) and 8% in trial 2 (1998), regardless of whether the bermudagrass was removed in March (fall 1996 only) or allowed to interfere the entire season (1-yr) (Table 4). The higher amount of yield loss in trial 1 compared to trial 2 might be attributed to more intense interference posed by bermudagrass in this year as verified by the higher bermudagrass biomass accumulation in trial 1 during the plant-cane crop compared with trial 2 (Table 1). In the first ratoon, yields were in most cases similar to the weed-free control (Table 4), with the only significant yield loss (9%) occurring in the 1-yr duration treatment of trial 2 (1999). In the second-ratoon crop, sugar yield was reduced 3 to 6% in all but the 2 yr of interference treatment in trial 1 (1999).

The lack of yield loss in the first ratoon shows the competitiveness of a ratoon-sugarcane crop with bermudagrass. This is typical of first-ratoon crops in Louisiana, where the first-ratoon crops are generally most vigorous because they are firmly established but have not yet began to decline due to disease, mechanical injury, etc., that develops as a problem in later ratoon crops that requires fields to be replanted.

Bermudagrass and sugarcane are both warm-season plants. The typical late harvest date for sugarcane (mid-November to early December), does not allow for bermudagrass reestablishment to any great extent following harvest; therefore, the competition between ratoon-crop sugarcane and bermudagrass is confined primarily to springtime and early summer. During the plant-cane crop, the effects of bermudagrass interference begin almost immediately following planting in late summer and continue until dormancy is induced during the winter months. Sugarcane production generally peaks during this first-ratoon crop with yields generally declining in the second-ratoon crop and beyond as sugarcane plants die

Table 4. Sugar yields over a 3-yr sugarcane production cycle, averaged over cultivar, resulting from differing durations of bermudagrass interference.

	Trial 1 (1997–1999)			Trial 2 (1998–2000)		
Duration of interference[a]	Plant	First ratoon	Second ratoon	Plant	First ratoon	Second ratoon
	kg sugar/ha					
Weed-free	14,130 a[b]	14,040 ab	12,980 a	11,860 a	13,580 ab	10,210 ab
Fall only	9,630 b	13,230 b	12,280 c	10,910 b	12,870 bc	10,540 a
1-yr	9,590 b	14,420 a	12,200 c	10,970 b	12,370 c	9,900 bc
2-yr		13,660 ab	12,820 ab		13,750 a	9,560 c
3-yr			12,550 bc			9,600 c

[a] Durations: Fall-only, after planting in the fall until early-spring; 1-yr, interference during the entire plant-cane crop; 2-yr, interference during both the plant-cane and first-ratoon crops; 3-yr, interference for entire 3-yr crop cycle.

[b] Means within columns followed by the same letter are not significantly different using the *F*-probability values and the PROC MIXED macro described by Saxton (1998) at alpha 0.05.

out due to disease, mechanical injury, weed encroachment, and possibly other causes. This decline also opens up space for further encroachment of weeds such as bermudagrass.

Significant bermudagrass interference during the plant-cane production year can result in poorer establishment and fewer harvestable stalks in not only the plant-cane crop but can also affect subsequent ratoon crops, even when bermudagrass is controlled within the later crop years. With a less dense infestation of bermudagrass, as occurred during the plant-cane crop of trial 2, number of harvestable sugarcane stalks was reduced less and the impacts of the interference did not occur until the first- and second-ratoon crops. Even though stalk populations and heights were reduced by bermudagrass competition, the biomass of bermudagrass did not increase above what occurred in the plant-cane crop. Shading of the bermudagrass by sugarcane was sufficient to induce dormancy, which combined with typical tillage application and harvesting, prevented further establishment of this weed.

One objective of this research was to identify differences in competitiveness between commonly grown sugarcane cultivars; we found differences to be very limited. Although CP 70-321 did emerge earlier than the other cultivars in the experiment, this was offset in many cases by its less dense stalk population. Although LCP 85-384 in many cases produced the highest number of stalks, this might have been offset by it slower emergence. HoCP 85-845 was intermediate in both of these traits. Perhaps a cultivar that both emerged quickly and produced a high number of stalks would have been more competitive than the cultivars tested in these experiments. However, a sugarcane cultivar with these characteristics was not commercially available in Louisiana to be used for testing this hypothesis.

We found no differences between the cultivars tested for their response to bermudagrass interference, whether comparing stalk production, height, or yield. Although there were phenotypic differences in the growth habit of the sugarcane cultivars used in this study, perhaps these differences were not substantial enough to provoke a response in sugarcane growth or yield. Sugarcane in this study proved to be quite competitive with bermudagrass, especially in the ratoon crop, regardless of which cultivar was grown. However, in order to avoid yield losses, especially in the plant-cane crop, bermudagrass should be controlled during the fallow season prior to planting.

Sources of Materials

[1] John Deere Thibodaux, Inc., (formerly CAMECO® Industries, Inc.), 244 Highway 3266, Thibodaux, Louisiana, 70301–1602

[2] RFM 190 Refractometer, Bellingham and Stanley Ltd., Longfield Rd., North Farm Industrial Estate, Tunbridge Wells, Kent, United Kingdom.

[3] Autopol 880 automated saccharimeter, Rudolph Research Analytical, 55 Newburgh Rd., Hackettstown, NJ 07840.

[4] SAS Software Version 9.1. Statistical Analysis Systems Institute, Cary, NC 27513.

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